

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		ATTORNEY'S DOCKET NUMBER NCX-001 (6909/3)
		U.S. APPLICATION NO. (If known, see 37 CFR 1.5) 09/868154
INTERNATIONAL APPLICATION NO. PCT/FR99/03099	INTERNATIONAL FILING DATE December 10, 1999	PRIORITY DATE CLAIMED December 14, 1998
TITLE OF INVENTION Device and Method for Processing a Sequence of Information Packets		
APPLICANT FOR DO/EO/US Hersent, Olivier		
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:		
<div>1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.</div> <div>2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.</div> <div>3. <input checked="" type="checkbox"/> This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9), and (21) indicated below.</div> <div>4. <input type="checkbox"/> The US has been elected by the expiration of 19 months from the priority date (Article 31).</div> <div>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2))<div>a. <input checked="" type="checkbox"/> is attached hereto (required only if not communicated by the International Bureau).</div><div>b. <input type="checkbox"/> has been communicated by the International Bureau.</div><div>c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US).</div></div> <div>6. <input checked="" type="checkbox"/> An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).<div>a. <input checked="" type="checkbox"/> is attached hereto. (along with a statement/declaration verifying the accuracy of the translation)</div><div>b. <input type="checkbox"/> has been previously submitted under 35 U.S.C. 154(d)(4).</div></div> <div>7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(C)(3))<div>a. <input type="checkbox"/> are attached hereto (required only if not communicated by the International Bureau).</div><div>b. <input type="checkbox"/> have been communicated by the International Bureau.</div><div>c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.</div><div>d. <input checked="" type="checkbox"/> have not been made and will not be made.</div></div> <div>8. <input type="checkbox"/> An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)).</div> <div>9. <input type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).</div> <div>10. <input type="checkbox"/> An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(C)(5)).</div> <div>Items 11 to 20 below concern document(s) or information included:</div> <div>11. <input type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98. (including 1 PTO 1449 form and Refs. A1, B1-B2, C1-C5).</div> <div>12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</div> <div>13. <input checked="" type="checkbox"/> A FIRST preliminary amendment.</div> <div>14. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment.</div> <div>15. <input type="checkbox"/> A substitute specification.</div> <div>16. <input type="checkbox"/> A change of power of attorney and/or address letter.</div> <div>17. <input type="checkbox"/> A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821-1.825.</div> <div>18. <input type="checkbox"/> A second copy of the published international application under 35 U.S.C. 154(d)(4).</div> <div>19. <input type="checkbox"/> A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).</div> <div>20. <input checked="" type="checkbox"/> Other items or information: Inventor Data Sheet; copy of International Preliminary Examination Report under PCT Article 36; copy of International Search Report; copy of Request; Formal Drawings (3 sheets); and a return receipt postcard.</div>		

U.S. APPLICATION NO. (if known, see 37 CFR 1.5) 09/868154		INTERNATIONAL APPLICATION NO. PCT/FR99/03099		ATTORNEY'S DOCKET NUMBER NCX-001	
21. <input checked="" type="checkbox"/> The following fees are submitted: BASIC NATIONAL FEE (37 CFR 1.492 (a)(1) – (5)): Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO..... \$1000.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO... \$860.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO..... \$710.00 International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4)..... \$690.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) \$100.00 ENTER APPROPRIATE BASIC FEE AMOUNT = \$860.00				CALCULATIONS PTO USE ONLY	
Surcharge of \$130.00 for furnishing the oath or declaration of later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				\$	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	5 - 20 =	0	X \$18.00	0.00	
Independent claims	2 - 3 =	0	X \$80.00	0.00	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ \$270.00	\$	
TOTAL OF ABOVE CALCULATIONS =				\$860.00	
<input checked="" type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.				\$0.00	
SUBTOTAL =				\$0.00	
Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				\$	
TOTAL NATIONAL FEE =				\$0.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property +				\$	
TOTAL FEES ENCLOSED =				\$860.00	
				Amount to be:	\$
				refunded	
				charged:	\$

- a. ☒ A check in the amount of **\$860.00** to cover the above fees is enclosed.
- b. ☐ Please charge my Deposit Account No. _____ in the amount of \$ _____ to cover the above fees.
- c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 20-0531. A duplicate copy of this sheet is enclosed.
- d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

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PATENT

Attorney Docket No. NCX-001

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT(S): Hersent
SERIAL NO.: Not Yet Assigned GROUP NO.: Not Yet Assigned
FILING DATE: June 14, 2001 EXAMINER: Not Yet Assigned
TITLE: Device and Method for Processing a Sequence of Information Packets

Assistant Commissioner for Patents
Washington, D.C. 20231
Box PCT, Attention Elected Office

PRELIMINARY AMENDMENT

Sir:

Please enter this Preliminary Amendment for the above-identified national phase application.

AMENDMENT

In the Title:

Please cancel the English version of the title of the invention as printed in the front page of the PCT publication, and substitute therefor:

-- DEVICE AND METHOD FOR PROCESSING A SEQUENCE OF INFORMATION PACKETS --.

In the Specification:

Page 3, before line 36, insert the heading:

-- BRIEF DESCRIPTION OF THE DRAWINGS --

Page 4, between lines 11 and 12, insert the heading:

-- DESCRIPTION OF PREFERRED EMBODIMENTS --

In the Abstract:

Please cancel the Abstract as printed in the front page of the PCT publication, and insert therefor the following Abstract.

-- ABSTRACT

The packets of the sequence are stowed away in a packets memory organized as a stack, in association with respective processing labels. The processing label associated with each packet extracted from the packets memory is examined so as to activate a processing module selected as a function of the label received. The activated module performs an elementary processing of the packet extracted. The elementary processing performed by at least one of the processing modules comprises associating the extracted packet with a label modified in accordance with a labels translation table, the processed packet subsequently being stowed away again in the packets memory in association with the modified label. --

In The Claims:

Please amend Claims 1-5 to read as follows. A set of amended claims, red-lined to show the amendments, is attached hereto.

1. (Amended) A device for processing a sequence of information packets, comprising:
 - a packets memory organized as a stack,
 - means for stowing away the packets of the sequence in association with respective processing labels,
 - a plurality of processing modules,
 - at least one labels translation table,
 - means for extracting packets from the packets memory, and
 - supervisory means for receiving the processing label associated with each packet extracted from the packets memory and activating one of the processing modules selected as a function of the label received, the activated module being arranged to perform an elementary processing of the extracted packet,
- whereby the elementary processing performed by at least one of the processing modules comprises associating the extracted packet with a label modified in accordance with a labels translation table, the processed packet subsequently being stowed away again in the packets memory in association with the modified label.

2. (Amended) A device according to claim 1, wherein a first processing label is associated initially with each packet of the sequence, wherein the supervisory means are arranged to activate a filtering module forming part of the plurality of processing modules in response to the receipt of the first processing label, and wherein the elementary processing performed by the filtering module comprises analyzing a header of the packet extracted and associating the packet with a second processing label dependent on a result of the analysis.

3. (Amended) A device according to claim 1, wherein the plurality of processing modules comprises an output module for transmitting the extracted packet to an output of the device, with a signature based on a secret shared with a concentrating router of a telecommunication network, authenticating that the packet has been subjected to the processing operations performed by the device.

4. (Amended) A method of processing a sequence of information packets, comprising the steps of:
stowing away the packets of the sequence in a packets memory organized as a stack, in association with respective processing labels, and
examining the processing label associated with a packet extracted from the packets memory so as to activate a processing module selected as a function of the label received from among an assembly a plurality of processing modules, whereby the activated module performs an elementary processing of the packet extracted,
wherein the elementary processing performed by at least one of the processing modules comprises associating the extracted packet with a label modified in accordance with a labels translation table, the processed packet subsequently being stowed away again in the packets memory in association with the modified label.

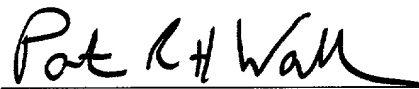
5. (Amended) A method according to claim 4, wherein, after having been subjected to various elementary processing operations, each packet is delivered with a signature based on a secret shared with a concentrating router of a telecommunication network, authenticating that the packet has been subjected to said elementary processing operations.

REMARKS

The present application is a national phase filing under 35 U.S.C. 371 of PCT/FR99/03099. PCT/FR99/03099 claims priority to FR No. 98/15757 filed on December 14, 1998, as indicated on the PCT cover page of the international application, as filed in French, submitted herewith. However, the English translation of the PCT cover page, attached to the English translation of the international application submitted herewith, refers incorrectly to PCT/FR99/03097 which claims priority to FR No. 98/15756. Nonetheless, the English translation of the international application submitted herewith refers correctly to PCT/FR/03099.

Applicant submits that the present amendments introduce no new matter. Claims 1-5 are pending in the application. The Examiner is invited to call the undersigned, if the Examiner believes that a telephone conversation could be helpful in expediting prosecution of the instant application.

Respectfully submitted,



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CLAIM AMENDMENTS (RED-LINED VERSION)

1. (Amended) A [D]device for processing a sequence of information packets, [characterized in that it comprises] comprising:

a packets memory [(35),] organized as a stack, [in which]

means for stowing away the packets [(30)] of the sequence [are stowed away] in association with respective processing labels [(36)], [an assembly]

a plurality of processing modules [(M1 - M5)],

at least one labels translation table,

means for extracting packets from the packets memory, and

supervisory means [(37)] for receiving the processing label associated with each packet extracted from the packets memory and activating one of the processing modules selected as a function of the label received, the activated module [undertaking] being arranged to perform an elementary processing of the extracted packet, [and in that]

whereby the elementary processing [undertaken] performed by at least one of the processing modules [(M2, M3)] comprises [the] associating [of] the extracted packet with a label modified in accordance with a labels translation table [(T2, T3)], the processed packet subsequently being stowed away again in the packets memory [(35)] in association with the modified label.

2. (Amended) A [D]device according to claim 1, [in which] wherein a first processing label is associated initially with each packet [(30)] of the sequence, [in which] wherein the supervisory means [(37)] are arranged to activate a filtering module [(M1)] forming part of the [assembly] plurality of processing modules in response to the receipt of the first processing label, and [in which] wherein the elementary processing [undertaken] performed by the filtering module comprises [an analysis of] analyzing a header of the packet extracted and [the] associating [of] the packet with a second processing label dependent on [the] a result of the analysis.

3. (Amended) A [D]device according to claim 1 [or 2, in which] wherein the [assembly] plurality of processing modules comprises an output module [(M5) which transmits] for transmitting the extracted packet to an output of the device, with a signature based on a secret shared with a concentrating router [(12)] of a telecommunication network [(10)], authenticating that the packet has been subjected to the processing operations performed by the device [(24)].

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. 62. 63. 64. 65. 66. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97. 98. 99. 100.

4. (Amended) A [M]method of processing a sequence of information packets, [characterized in that] comprising the steps of:

DEVICE AND METHOD FOR PROCESSING A SEQUENCE OF
INFORMATION PACKETS

The present invention relates to packet based
5 transmission networks. It applies in particular, but
not exclusively, to networks operating according to the
Internet protocol (IP).

The invention can be implemented at the level
of the outside interfaces of routers of the network, so
10 as to perform analyses and processing of the data
streams travelling through these interfaces.

Here, the expression "police" functions
designates various processing or control operations
performed at the level of such an interface on data
15 streams which pass through it. By way of nonlimiting
examples, mention may be made of the counting of the
packets exchanged between a given source address and a
given destination address, the allocating of priorities
to certain packets, address translations, the selective
20 destruction of certain packets, etc.

These police functions may be included within a
contractual framework between a subscriber and a
manager of the network. Such may for example be the
case with functions relating to flow control, to
25 authorization for access to certain sites linked to the
network, to the implementing of reservation protocols
such as RSVP, etc. They may also be included within the
framework of the internal organization of a public or
private network, for example to control certain
30 accesses.

Current routers offer a set of configuration
commands making it possible to apply such police
functions. Thus, a filter relating to certain fields of
the header of the packets is defined so as to identify
35 the stream or streams concerned, the filter being
associated with a particular function operated on the
corresponding packets. These filters, or "access list",

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exhibit certain inflexibilities. Thus, it is not possible to string two filters together, one specifying a sort on the packets selected by the first. These filters are constructed on a sequential model: the first filter which is suitable for a given packet is adopted with the exclusion of the following filters which might also be suitable. It is therefore impossible to apply several rules and associated processing operations to one and the same stream (for example to count all the packets transmitted according to the TCP protocol on a port x and to count all the TCP streams heading for a given server, including those traveling toward the port x).

To sidestep certain of these limitations, commands performing several joint actions have been defined. These solutions afford only relative flexibility and appreciably complicate the language for configuring the routers. A homogeneous framework for managing the future extensions of the police functions to be undertaken is also lacking.

An aim of the present invention is to propose a mode of processing sequences of information packets which offers high flexibility of configuration without significantly increasing the complexity of the configuration interface.

The invention thus proposes a device for processing a sequence of information packets, comprising a packets memory, organized as a stack, in which the packets of the sequence are stowed away in association with respective processing labels, an assembly of processing modules, and supervisory means receiving the processing label associated with each packet extracted from the packets memory and activating one of the processing modules selected as a function of the label received, the activated module undertaking an elementary processing of the extracted packet. The elementary processing undertaken by at least one of the

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processing modules comprises the associating of the
extracted packet with a label modified in accordance
with a labels translation table, the processed packet
subsequently being stowed away again in the packets
5 memory in association with the modified label

The device makes it possible to string together
police functions according to an arbitrary graph of
elementary processing operations acting on data streams
identified by the processing labels. This affords a
10 flexible framework for managing the configuration of
the interface and any protocol extensions.

The performance of the device is independent of
the number of strings of elementary processing
operations which may be performed on the streams
15 traveling through the interface, and proportional to
the more complex of these strings. On the other hand,
the technique used consumes more memory than a
conventional sequential implementation.

Another aspect of the present invention
20 concerns a method of processing a sequence of
information packets, in which the packets of the
sequence are stowed away in a packets memory organized
as a stack, in association with respective processing
labels, the processing label associated with each
25 packet extracted from the packets memory is examined so
as to activate a processing module selected as a
function of the label received from among an assembly
of processing modules, the activated module undertaking
an elementary processing of the packet extracted. The
30 elementary processing undertaken by at least one of the
processing modules comprises the associating of the
extracted packet with a label modified in accordance
with a labels translation table, the processed packet
subsequently being stowed away again in the packets
35 memory in association with the modified label.

Other features and advantages of the present
invention will become apparent in the following

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description of nonlimiting exemplary embodiments, with reference to the appended drawings, in which:

- figure 1 is a diagram of a network where the invention may be implemented;

5 - figure 2 is a schematic diagram of an access router of a private installation of this network;

- figure 3 is a schematic diagram of a stream processing device forming part of an interface of the router of figure 2; and

10 - figure 4 is a graph of elementary processing operations undertaken by the device of figure 3.

Figure 1 shows a wide area shared network (WAN) comprising a certain number of interconnected routers and switches 11, 12. The case where the shared network 10 operates according to the IP protocol is considered here. A certain number of the routers are concentrating routers 12 to which private installations 13 are linked.

A private subscriber installation 13 is typically linked to the shared network 10 by means of an access router 15, one of whose interfaces 16 is linked to a line 17 for transmission from and to the concentrating router 12. The access router 15 can be linked to other routers of the private installation 13 or to servers or terminals 18 of this installation, by means of other interfaces, which are not represented in figure 1.

Figure 2 shows an exemplary architecture of the access router 15. The outside interface 16, and also the interfaces 20, 21 with the remainder of the private installation 13, are linked to the core of the router consisting of a packet forwarding engine 22. The forwarding engine 22 forwards the packets from one interface to another on the basis of the address fields and port fields contained in the headers of the packets in accordance with the IP protocol and with any

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extensions thereof (TCP, UDP, etc.), by referring to routing tables.

Certain of the interfaces of the access router 15 are provided, in just one or in both directions of transmission, with processing devices, or stream processors, 24, 25 undertaking police functions. In the illustrative example of figure 2, the device 24 is fitted to the outside interface 16 in the outgoing direction, and the device 25 is fitted to another interface 20 in the incoming direction.

The access router is supervised by a management unit 26 which can consist of a microcomputer or a work station which executes routing software serving in particular to configure the routing table of the forwarding engine 22 and the stream processors 24, 25 and to exchange control or protocol information with them. These commands and exchanges are effected by way of an appropriate software programming interface (API).

Most of the existing packet routing and forwarding software is readily available in the Unix environment, but its performance is customarily limited on account of the frequent interruptions of the operating system. It is much faster to use a real time operating system such as VxWorks, but this complicates the implementation of the routing software.

The role of the stream processors 24, 25 is to assist the non-real time operating system (such as Unix), on the basis of which the management unit 26 functions, in the complex tasks for manipulating the streams which require real time performance (forwarding, filtering, enciphering, etc.). These processors implement a certain number of tools for manipulating the streams which may be linked dynamically according to any combination so as to perform the task required. This configuration can be achieved through the Unix operating system by calling

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the API functions, thereby greatly facilitating the setting up of new functionalities by the programmer.

As illustrated diagrammatically by figure 1, one of the tasks performed by the stream processor 24 of the outside interface 16 of the access router 15 consists in transmitting each packet to the concentrating router 12 while appending a digital signature (block 40) thereto. This signature attests that the packets in question have been subjected to the other stream control operations (block 39) performed by the processor 24.

The corresponding interface 28 of the concentrating router 12 comprises a module for analyzing the packets received on the line 17 so as to make sure that the signature is present.

This signature technique advantageously makes it possible to decentralize the stream control operations necessary for the contractual relations between the manager of the concentrating router 12, which provides the service of attachment to the shared network 10, and the subscribers whose installations 13 are linked to this concentrating router 12. In the conventional embodiments, these stream control operations are performed at the level of the concentrating router. This results in considerable complexity of the concentrating router when it is attached to a fairly large number of private installations, and a lack of flexibility for the subscribers when modifications are required.

By performing these stream control operations at the level of the access routers 15, great flexibility is afforded in this regard. The signing of the packets then guarantees to the service provider that the line 17 does not send him valid packets which depart from the contractual framework with the subscriber. If such a packet were to appear, the interface 28 of the concentrating router 12 would

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simply eliminate it after having noted the absence of the appropriate signature.

Various conventional processes may be used to construct and analyze the signature of the packets, on the basis of a secret shared between the routers 12 and 15. The signature can in particular have the form of a code word added to the content of the packet, and calculated on the basis of all or part of this content and of a secret key, the calculation being performed with the aid of a function which is extremely difficult to invert in order to recover the secret key. It is thus possible to use a technique of hashing the content of the packet, or of just a part of this content, for example an MD5 hashing (see R. Rivest, RFC 1231, "The MD5 Message Digest Algorithm").

It is also possible to use an enciphering process to form the signature of the packets. The content of the packet is then enciphered with the aid of a private key, the interface 28 of the concentrating router undertaking the corresponding deciphering with the aid of a public or private key. The unenciphered packets, or those enciphered by means of a wrong key are then destroyed at the level of the interface 28.

As an option, provision may be made for the interface 28 of the concentrating router to also sign the packets which it transmits on the line 17, and for the interface 16 of the access router to verify this signature so as to make sure that the packets received are valid.

Figure 3 shows the organization of a stream processor 24 or 25 of an interface of the access router 15.

The stream processor receives a sequence of incoming packets 30 each comprising a header 31 in accordance with the IP protocol, and delivers a sequence of outgoing packets 32 having a header 33 after having performed certain elementary processing

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operations whose nature depends on the data streams concerned.

The incoming packets 30 are stowed away in a packets memory 35 organized as a first in-first out (FIFO) stack. Each packet is fed to the memory 35 with a processing label 36. The processing label initially has a specified value (0 in the example represented) for the incoming packets 30.

The stream processor is supervised by a unit 37 which cooperates with a table 38 making it possible to associate a particular processing module with each value of the processing label. In the simplified example represented in figure 3, the stream processor comprises an assembly of five processing modules M1 - M5 effecting elementary processing operations of different kind.

After the execution of an elementary processing operation, the supervisory unit 37 consults the packets memory 35. If the latter is not empty, a packet is extracted therefrom according to the FIFO organization. The supervisory unit 37 consults the table 38 to determine which processing module corresponds to the label of this packet. The unit 37 then activates the module in question so that it performs the corresponding elementary processing operation. In certain cases, this elementary processing operation may entail a modification of the content of the packet, in particular its header.

It will be understood that the "extraction" of the packet, to which reference is made, is an extraction in the logical sense from the FIFO memory. The packet is not necessarily removed from the memory. The addresses of the packets in the memory 35 can be managed in a conventional manner by means of pointers so as to comply with the FIFO organization. The activated processing module can be furnished simply with the address of the current packet so as to perform

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the required reads, analyses, modifications or deletions as appropriate.

The first processing module M1, associated with the initial label 0, is a filtering module which analyzes the address field and/or protocol definition field and/or port field of the IP header of the packets. With the help of an association table T1, the filtering module M1 delivers a second processing label which identifies a string of elementary processing operations which will subsequently have to be performed on the packet. After having determined the second processing label for the packet extracted from the memory 35, the filtering module M1 stows away the packet in the memory 35 again, with the second processing label. The next elementary processing operation will then be executed when the packet is again extracted from the memory.

The module M2 is a module for counting the packets relating to certain streams. In the case of the association table 38 represented in figure 3, this module M2 is called for the processing labels 2 and 4. When it processes a packet, the module M2 increments a counter with the number of bytes of the packet, or else with the value 1 in the case of a packets counter. The counter can be made secure, in particular if it serves for the billing of the subscriber by the manager of the network 10. In the case of a secure counter, requests are regularly made to the access provider to obtain transmission credits, the relevant packets being destroyed if the credit is used up.

The module M3 of figure 3 is a priorities management module. In the case of the association table 38 represented in figure 3, this module M3 is called for the processing label 3. The module M3 operates on the TOS ("Type of Service") field of the IP header of the packets. The TOS is used in the network to manage forwarding priorities so as to provide a certain

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quality of service on certain links. The TOS field can be changed according to prerecorded tables. These tables can be defined under the control of the access provider so as to prevent packets being inappropriately transmitted with a high priority, which might disturb the network.

The elementary processing operation performed last on a packet of the memory 35 is either its destruction (module M4 activated by the label 8), or its resubmission to the output of the stream processor (module M5 activated by the label 5 or 9). The module M4 can be used to destroy packets having a certain destination and/or a certain origin.

The modules M2 and M3, which do not terminate the processing operations to be undertaken in respect of a packet (except in the case of destruction), each operate with a label translation table T2, T3. This translation table designates, for the processing label extracted from the memory 35 with the current packet, another processing label designating the next elementary processing operation to be undertaken. The elementary processing operation undertaken by this module M2 or M3 terminates with the associating of the packet with this other processing label and the reinjecting of the packet thus processed into the memory 35.

In this way, highly varied combinations of processing operations can be performed on the various data streams passing through the processor.

Figure 4 shows a simplified example corresponding to the tables 38, T1 - T3 represented in figure 3. The incoming packet 30, associated with the first label 0, is firstly subjected to the filtering effected by the module M1.

In the particular case considered, the stream processor 24 counts the packets transmitted from a source address AS1 to a destination address AD1 and a

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port P1, and modifies the TOS field of these packets before delivering them on the line 17, this corresponding to the upper branch of the graph of figure 4. Moreover, the stream processor 24 counts the packets emanating from a source address AS2 heading for a port P2 before destroying them, this corresponding to the lower branch of figure 4. The other packets are simply delivered to the line 17. The default value (9) of the processing label returned by the module M1 therefore simply designates the output module M5. If the module M1 detects in the packet extracted from the memory 35 the combination AS1, AD1, P1 in the relevant address and port fields, it returns the packet with the processing label 2. If the values AS2, P2 are detected in the address and port fields, it is the label 4 which is returned with the packet.

These labels 2 and 4 both correspond to the counting module M2. The label will also designate for this module the memory address of the counter which has to be incremented. The table T2 with which the module M2 operates will make it possible at the end of processing to perform the return to the next module to be activated (M3 designated by the label 3 for the packets whose TOS has to be changed, M4 designated by the label 8 for the packets to be destroyed).

The module M3 receives packets with the processing label 3, and returns them with the label 9 after having made the required modification of the TOS field.

From this simplified example it can be seen that the stream processor makes it possible, through the identification of a stream by the filtering module M1, to perform various combinations of elementary processing operations in a relatively simple and fast manner.

A main advantage of this way of proceeding is the flexibility of the operations for configuring the

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stream processor. The tables 38, T1 - T3 which define any graph of elementary processing operations, such as the one represented in figure 4, can be constructed relatively simply and with a small real time constraint by means of the management unit 36 through the API. The same holds in respect of the information enabling the modules M1 - M5 to perform their elementary processing operations (description of the counts to be performed by the module M2, way of changing the TOS fields by the module M3, etc.).

In practice, the stream processor may comprise various processing modules other than those represented by way of example in figures 3 and 4, according to the requirements of each particular installation (for example, module for managing the output queues, address translation module, etc.).

The function of signing the packets transmitted, which was described earlier, can form part of the elementary processing undertaken by the output module M5. In a typical embodiment of the access router, the stream processor 24 will be included in an application specific integrated circuit (ASIC) organized around a microcontroller core. This embodiment allows there to be no physical access between the stream control modules 39 (at least those which pertain to the relations between the subscriber and the manager of the network 10) and the module M5 which is responsible for signing the packets, corresponding to the block 40 of figure 1. This improves the security of the link from the viewpoint of the manager of the network.

CLAIMS

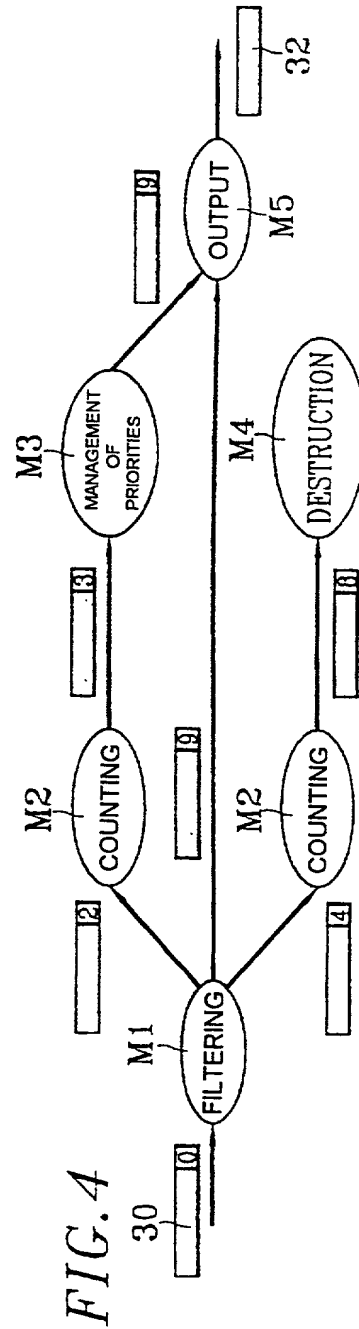
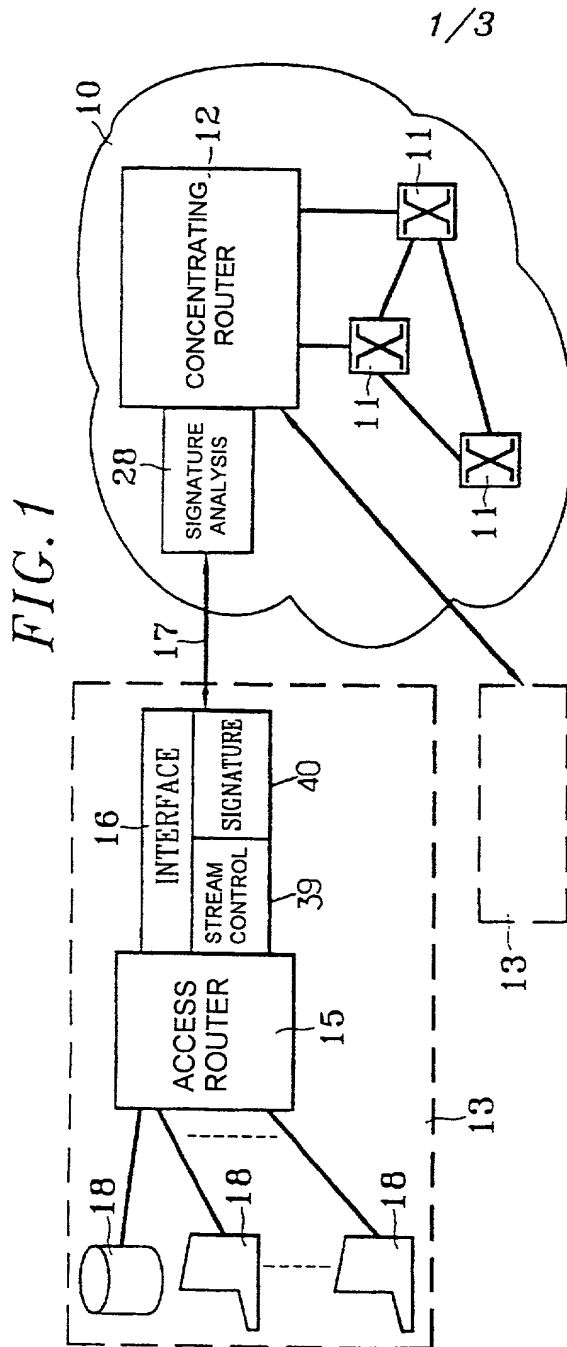
1. Device for processing a sequence of information packets, characterized in that it comprises a packets
5 memory (35), organized as a stack, in which the packets (30) of the sequence are stowed away in association with respective processing labels (36), an assembly of processing modules (M1 - M5), and supervisory means (37) receiving the processing label associated with
10 each packet extracted from the packets memory and activating one of the processing modules selected as a function of the label received, the activated module undertaking an elementary processing of the extracted packet, and in that the elementary processing
15 undertaken by at least one of the processing modules (M2, M3) comprises the associating of the extracted packet with a label modified in accordance with a labels translation table (T2, T3), the processed packet subsequently being stowed away again in the packets
20 memory (35) in association with the modified label.
2. Device according to claim 1, in which a first processing label is associated initially with each packet (30) of the sequence, in which the supervisory means (37) activate a filtering module (M1) forming
25 part of the assembly of processing modules in response to the receipt of the first processing label, and in which the elementary processing undertaken by the filtering module comprises an analysis of a header of the packet extracted and the associating of the packet
30 with a second processing label dependent on the result of the analysis.
3. Device according to claim 1 or 2, in which the assembly of processing modules comprises an output module (M5) which transmits the extracted packet to an
35 output of the device, with a signature based on a secret shared with a concentrating router (12) of a telecommunication network (10), authenticating that the

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packet has been subjected to the processing operations performed by the device (24).

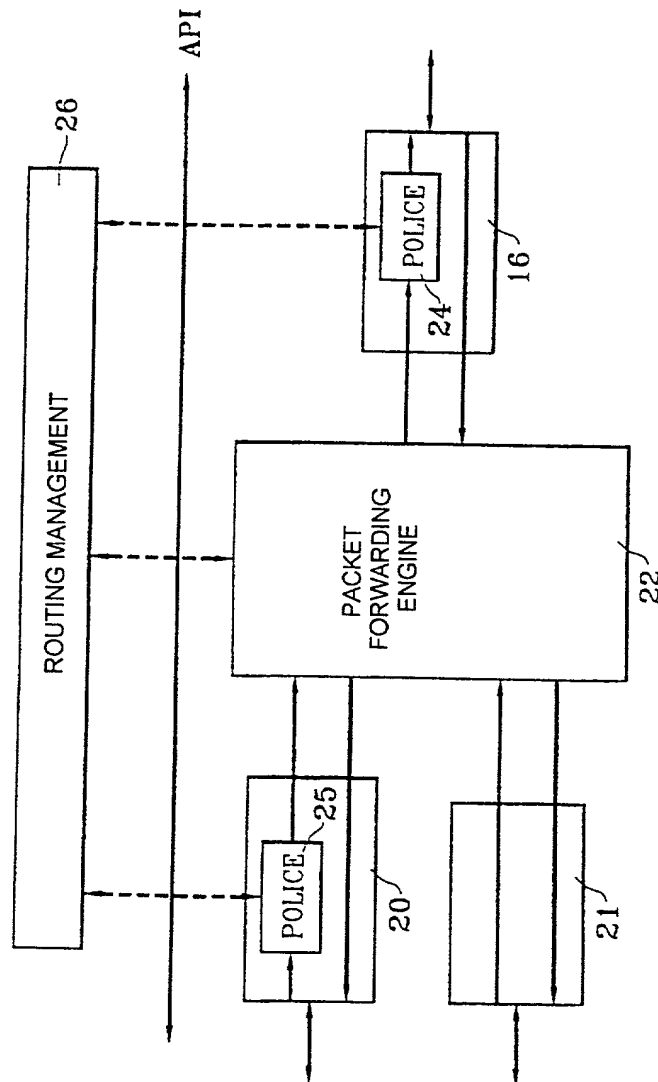
4. Method of processing a sequence of information packets, characterized in that the packets (30) of the sequence are stowed away in a packets memory (35) organized as a stack, in association with respective processing labels (36), the processing label associated with each packet extracted from the packets memory is examined so as to activate a processing module selected as a function of the label received from among an assembly of processing modules (M1 - M5), the activated module undertaking an elementary processing of the packet extracted, and in that the elementary processing undertaken by at least one of the processing modules (M2, M3) comprises the associating of the extracted packet with a label modified in accordance with a labels translation table (T2, T3), the processed packet subsequently being stowed away again in the packets memory in association with the modified label.

5. Method according to claim 4, in which, after having been subjected to various elementary processing operations, each packet is delivered with a signature based on a secret shared with a concentrating router (12) of a telecommunication network (10), authenticating that the packet has been subjected to said elementary processing operations.



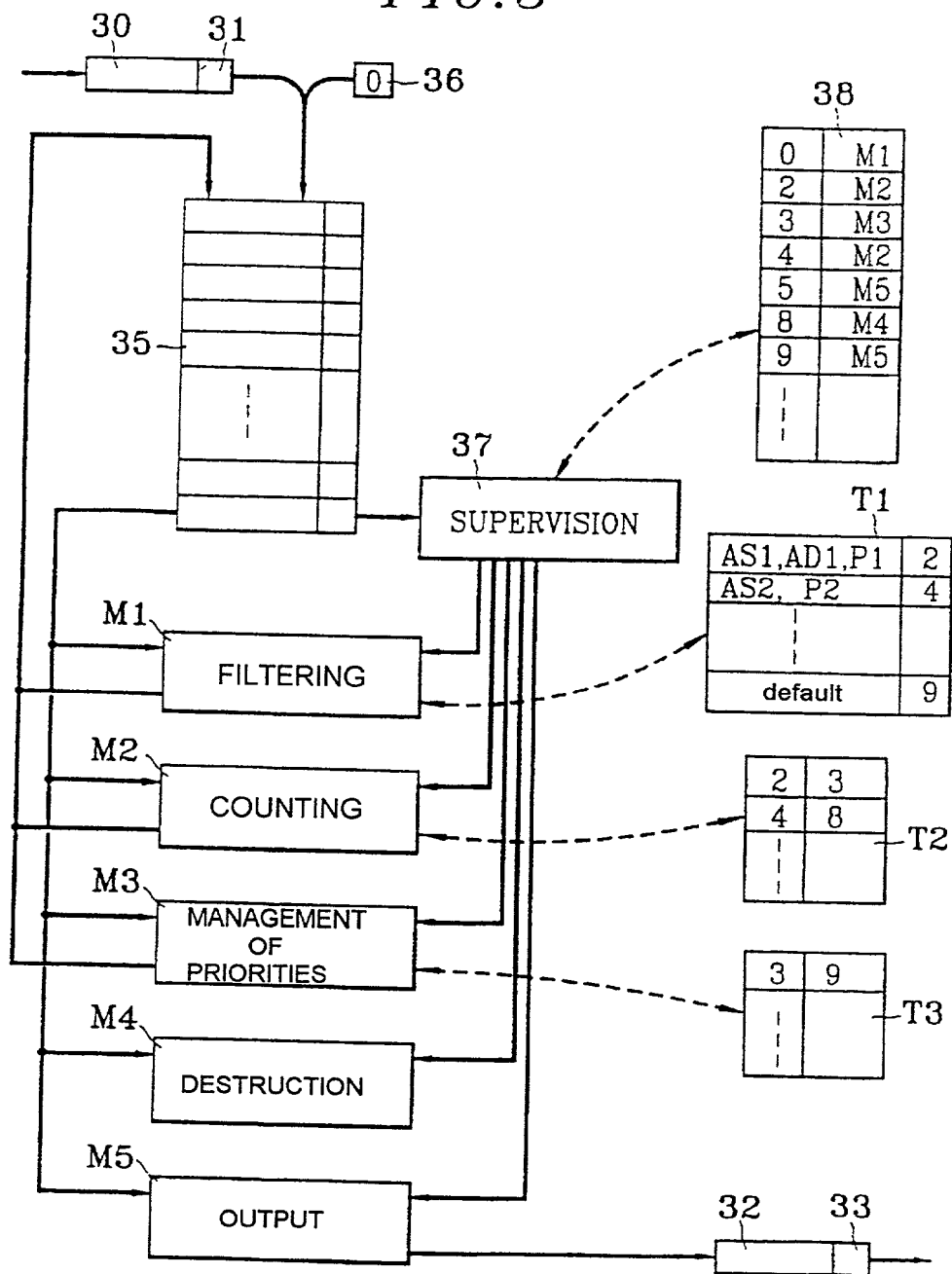
2/3

FIG. 2



3/3

FIG. 3



| | | |
|---|---------------------------|-----------------|
| DECLARATION AND POWER
OF ATTORNEY FOR UTILITY
OR DESIGN

PATENT APPLICATION

<input type="checkbox"/> Declaration <input checked="" type="checkbox"/> Declaration
Submitted with Submitted after Initial
Initial Filing Filing (surcharge
37 CFR 1.16(e) required) | Attorney Docket No. | NCX-001 |
| | First Named Inventor | Olivier HERSENT |
| | COMPLETE IF KNOWN | |
| | Application Serial Number | 09/868,154 |
| | Filing Date | June 14, 2001 |
| | Group Art Unit | |
| | Examiner Name | |

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

DEVICE AND METHOD FOR PROCESSING A SEQUENCE OF INFORMATION PACKETS

(Title of the Invention)

the specification of which

☒ is attached hereto
OR

☒ was filed on December 10, 1999 as United States Application Serial Number or PCT International (MM/DD/YYYY)

Application Number PCT FR99/03099 and was amended on (MM/DD/YYYY) (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified application, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose to the Patent Office all information known by me to be material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

| Prior Foreign Application
Number(s) | Country | Foreign Filing Date
(MM/DD/YYYY) | Priority
Not Claimed | Certified Copy Attached? | |
|--|---------|-------------------------------------|--------------------------|--------------------------|--------------------------|
| | | | | YES | NO |
| 9815757 | FRANCE | 12/14/1998 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | | | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | | | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | | | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

☐ Additional foreign application numbers are listed on a supplemental priority data sheet attached hereto.

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

| Application Serial Number(s) | Filing Date (MM/DD/YYYY) |
|------------------------------|--------------------------|
| | |
| | |
| | |

☐ Additional provisional application serial numbers are listed on a supplemental priority data sheet attached hereto.

Declaration and Power of Attorney for Utility or Design Patent Application

Serial No.

Atty. Docket No.

Page 2 of 2

DECLARATION – Utility or Design Patent Application

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c), of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

**U.S. Parent Application or PCT Parent
Serial Number****Parent Filing Date
(MM/DD/YYYY)****Parent Patent Number
(if applicable)**

PCT FR99/03099

12/10/1999

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet attached hereto.

As a named inventor, I hereby appoint the following registered practitioners to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: ☐ Customer Number ☐ Registered practitioner(s) name/registration number listed below

OR

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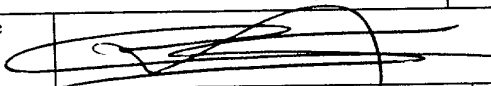
| Name | Registration Number | Name | Registration Number |
|------------------------|---------------------|-----------------------|---------------------|
| Michael J. Bastian | 47,411 | Kurt W. Lockwood | 40,704 |
| Steven M. Bauer | 31,481 | Thomas C. Meyers | 36,989 |
| Elias C. Behrakis | 47,416 | Joseph B. Milstein | 42,897 |
| John V. Bianco | 36,748 | David G. Miranda | 42,898 |
| Isabelle A.S. Blundell | 43,321 | Ronda P. Moore | 44,244 |
| Maureen A. Bresnahan | 44,559 | Indranil Mukerji | P-46,944 |
| Michael H. Brodowski | 41,640 | Edmund R. Pitcher | 27,829 |
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| Joseph A. Capraro, Jr. | 36,471 | Jamie H. Rose | 45,054 |
| John J. Cotter | 38,116 | R. Stephen Rosenholm | 45,283 |
| John V. Forcier | 42,545 | Christopher W. Stamos | 35,370 |
| Steven J. Frank | 33,497 | Diana M. Steel | 43,153 |
| Kia L. Freeman | 47,577 | Joseph P. Sullivan | 45,349 |
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| William G. Guerin | 41,047 | Patrick R.H. Waller | 41,418 |
| Jonathan A. Harris | 44,744 | Daniel A. Wilson | 45,508 |
| Ira V. Heffan | 41,059 | Gerald E. Worth | 45,238 |
| Danielle L. Herritt | 43,670 | Yin P. Zhang | 44,372 |
| Douglas J. Kline | 35,574 | | |
| John D. Lanza | 40,060 | | |

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

| | | | | | | | |
|--|------|---|---------|------------------------|--------|--|----------|
| Name of Sole or First Inventor: | | <input type="checkbox"/> A petition has been filed for this unsigned inventor | | | | | |
| Given Name (first and middle [if any]) | | | | Family Name or Surname | | | |
| Olivier | | | | HERSENT | | | |
| Inventor's Signature | |  | | | Date | | 19.06.01 |
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| <input type="checkbox"/> Additional inventors are being named on the _____ supplemental Additional Inventor(s) sheet(s) attached hereto. | | | | | | | |
| Name of Additional Joint Inventor, if any: | | <input type="checkbox"/> A petition has been filed for this unsigned inventor | | | | | |
| Given Name (first and middle [if any]) | | | | Family Name or Surname | | | |
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| Inventor's Signature | | | | | Date | | |
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